SEMIANNUAL REPORT

Aggregated Data from the National Nosocomial Infections Surveillance (NNIS) System
June 1999

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INTRODUCTION

The data in the SEMIANNUAL REPORT (SAR) are collected by hospitals that voluntarily participate in the National Nosocomial Infections Surveillance (NNIS) system and routinely report their data to the Centers for Disease Control and Prevention. The hospitals use the NNIS surveillance components, which are protocols that target specific patient groups with similar infection risks, to collect the data.

In January of 1999, the Hospital-wide component was eliminated from the NNIS system. This was done for several reasons. The Hospital-wide component required considerable time and resources in most hospitals, particularly those that have a large and high-risk patient population, resulting in inaccurate and inadequate casefinding. More importantly, the Hospital-wide Component did not yield rates that were meaningful for national comparison purposes since they were not risk adjusted.

Tables 1 and 2 update the device-associated rates and device utilization ratios from the ICU component reported in the last SAR, issued in December 1998. For the first time, the percentile distributions of device-associated infection rates and device utilization ratios in trauma ICUs are displayed. In the last SAR we separated for the first time combined Medical/Surgical ICUs into two groups by type of hospital: **Major Teaching** and **All Other**. The combined Medical/Surgical ICUs from major teaching hospitals had significantly higher infection rates and device utilization ratios than combined medical/surgical ICUs from all of the other hospitals. **Major Teaching** status is defined as a hospital that is an important part of the teaching program of a medical school and a major unit in the clinical clerkship program. Teaching affiliation was not an important factor for any other type of ICU.

We require a minimum of **50 device-days** in the denominator of an ICU to calculate a device-associated infection rate. Similarly, device utilization ratios are calculated for ICUs that reported at least **50 patient-days**. The distribution of device utilization ratios can be useful as a guide for assessing the appropriateness of device use in your hospital's ICU. The percentile distributions that display the infection rates and device utilization ratios require data from at least 20 different units. The number of units reporting data from the burn and respiratory ICUs is still insufficient to provide percentile distributions for these types of ICUs.

Tables 3-5 update the distribution of the most common pathogens isolated from the 3 most frequently occurring infection sites in the ICU–bloodstream infections, pneumonias, and urinary tract infections–in different types of ICU. The differences in pathogens by the type of ICU for the same infection site suggest that ICU type may serve as an indirect marker of case mix. Please note that these tables in the December 1998 SAR contained occasional errors in the number of isolates reported when the number exceeded 4 digits, however, the percentages were correct.

Figure 1 updates the rates of antimicrobial resistance among selected pathogens identified from ICU patients with nosocomial infections. Several important points are made in the table. First, we provide the pooled mean rate of resistance for January-May 1999. Second, we graph this rate next to the average rate of resistance (± 1 standard deviation) over the previous 5 years, for each pathogen. Finally, we calculate the percentage increase in the resistance rate during this time period in 1999 compared to the previous 5 years. The continuing increase in antimicrobial resistance in U.S. hospitals remains a concern. Of note, the proportion of *S. aureus* isolates that

were resistant (MRSA) continues to rise, and is over 50% for the first time ever. Also, the rate of resistant enterococci (VRE) has not slowed and about one quarter of all enterococcal infections are now resistant to vancomycin. Although these data are limited to patients in ICUs, they are not risk-adjusted and comparisons of these rates between hospitals should be made with caution.

Tables 6 and 7 show updated data from the HRN component.

The data in tables 8-10 are unchanged from the previous SAR. Table 8 displays SSI rates by operative procedure and NNIS risk index category. When the SSI rates for adjacent risk categories for a particular operation were not statistically different, we combined them into a single risk category. For example, because the SSI rates for herniorrhaphies with 2 or 3 risk factors were similar, we collapsed the data for these two categories into one category designated as '2,3'. Thus, the number of risk index categories in the tables will differ depending upon the operation.

Table 9 contains the percentile distributions for each operative procedure and SSI risk index category. For a hospital to be represented in this distribution, it must have reported sufficient data, which means it reported at least **30 operations** in a given SSI risk category. Note that percentile distributions are not available for every operative procedure-risk category since percentile distributions of the procedure-specific and risk-index specific rates required sufficient data from at least **20 hospitals**.

Table 10 lists four operations in which the use of a laparoscope has been incorporated into the SSI risk index. Laparoscopes and endoscopes (SCOPE) are being used with increasing frequency to perform operations. The SCOPE was used most frequently on the following procedures: Cholecystectomy (64%), Appendectomy (19%), Vaginal Hysterectomy (15%), Other Ear, Nose, or Throat (14%), Other Genitourinary (10%), Gastric Surgery (8%), Exploratory Laparotomy (7%), Other Musculoskeletal (7%), Thoracic (7%), Herniorrhaphy (4%), and Colon Surgery (3%). SCOPE was used to perform the other remaining operative procedures less than 2% of the time. For four operations, the SSI rate was significantly different when SCOPE was used. When other risk factors were controlled, **Cholecystectomy, Colon Surgery, Gastric Surgery,** and **Appendectomy** had lower SSI rates when a SCOPE was used. However, there were some differences among these operations. For Cholecystectomy and Colon Surgery, the influence of SCOPE was captured by subtracting one from the number of risk factors (ASA score of 3,4, or 5; duration of surgery > 75th percentile; or contaminated or dirty wound class) whenever the procedure was done laparoscopically; M indicates minus 1 (-1) in the modified risk category where no risk factors were present and the procedure was performed with a laparoscope. For Appendectomy and Gastric Surgery, the use of a SCOPE was only important if the patient had no other risk factors. Therefore, we split the index value of zero risk factors into 0-No and 0-Yes. The percentile distributions of the four operative procedures with modified SSI risk index categories have not been developed at this time.

Table 11 displays updated SSI rates by specific site following coronary artery bypass graft (CBGB) operations where incisions are made at both the chest and the donor sites.

Appendix A and B provide instructions on how to calculate the rates and ratios found in the SAR and how to interpret the data. All individuals who analyze and use surveillance data must remember that a high rate or ratio (>90th percentile) does NOT define a problem, it only

suggests an area for further investigation. Appendix C shows NNIS personnel how to use IDEAS to calculate SSI rates collected through the Surgical Patient surveillance component.

Table 1. Intensive care unit surveillance component. Pooled means and percentiles of the distribution of device-associated infection rates, by type of ICU, NNIS system, January 1992-May 1999

Urinary catheter-associated UTI rate*

Type of ICU	No. of Units	Urinary Catheter-Days	Pooled Mean	Percentile				
				10%	25%	50% (median)	75%	90%
Coronary	105	345,618	6.8	1.1	3.3	5.9	10.0	13.7
Cardiothoracic	48	350,359	3.3	0.6	1.5	2.7	4.2	5.4
Medical	124	746,926	7.6	2.1	4.2	7.0	9.1	12.0
Medical/Surgical Major teaching	71	339,039	6.8	2.1	4.4	6.5	9.8	11.0
Medical/Surgical All others	140	874,163	4.5	1.2	2.2	4.4	6.0	8.1
Neurosurgical	46	194,474	8.4	2.9	4.9	8.1	10.0	14.7
Pediatric	65	177,945	5.2	0.0	2.6	4.9	7.2	11.0
Surgical	146	1,017,283	5.6	1.2	3.2	5.0	7.9	9.2
Trauma	21	128,958	7.7	2.7	4.3	7.7	9.5	11.1
Burn	17	32,723	10.1	.	.	.	.	.
Respiratory	7	28,699	6.4	.	.	.	.	.

Central line-associated BSI rate**

Type of ICU	No. of Units	Central line-Days	Pooled Mean	Percentile				
				10%	25%	50% (median)	75%	90%
Coronary	106	216,837	4.9	0.0	1.8	4.1	6.5	8.9
Cardiothoracic	48	324,182	2.9	0.4	1.4	2.3	3.6	5.2
Medical	124	531,300	6.1	2.2	3.8	5.4	7.3	9.8
Medical/Surgical Major teaching	72	238,446	6.0	1.5	3.5	5.7	7.6	9.3
Medical/Surgical All others	138	532,464	4.1	1.1	2.2	4.0	5.6	7.2
Neurosurgical	45	104,285	5.6	1.8	3.0	4.5	8.4	9.2
Pediatric	67	248,610	7.9	1.4	4.5	6.9	9.6	12.3
Surgical	146	819,268	5.6	1.4	2.6	5.0	7.0	9.3
Trauma	21	94,185	7.3	0.0	2.6	6.4	8.6	9.3
Burn	17	25,660	12.2	.	.	.	.	.
Respiratory	7	15,732	4.3	.	.	.	.	.

Ventilator-associated pneumonia rate***

Type of ICU	No. of Units	Ventilator-Days	Pooled Mean	Percentile				
				10%	25%	50% (median)	75%	90%
Coronary	101	144,455	9.4	0.0	3.4	6.8	12.0	16.5
Cardiothoracic	48	193,159	11.5	2.6	5.6	11.0	14.1	20.1
Medical	121	505,023	8.2	1.9	4.2	7.3	10.6	15.3
Medical/Surgical Major teaching	71	191,053	12.4	3.6	6.9	10.3	14.4	18.2
Medical/Surgical All others	138	419,304	10.3	3.6	6.3	9.4	12.6	15.6
Neurosurgical	45	91,508	17.1	3.1	7.6	12.7	18.7	23.6
Pediatric	66	256,919	5.7	0.1	1.9	4.6	7.9	11.8
Surgical	146	569,271	14.6	5.6	8.4	12.3	16.4	25.6
Trauma	21	83,690	16.9	6.4	10.9	14.7	21.2	27.2
Burn	17	19,378	19.9	.	.	.	.	.
Respiratory	7	22,913	5.3	.	.	.	.	.

* Number of urinary catheter-associated UTIs x 1000
Number of urinary catheter-days

** Number of central line-associated BSIs x 1000
Number of central line-days

*** Number of ventilator-associated pneumonias x 1000
Number of ventilator-days

Table 2. Intensive care unit surveillance component. Pooled means and percentiles of the distribution of device utilization ratios, by type of ICU, NNIS system, January 1992-May 1999

Urinary catheter utilization*

Type of ICU	No. of Units	Patient-Days	Pooled Mean	Percentile				
				10%	25%	50% (median)	75%	90%
Coronary	107	770,739	0.45	0.22	0.35	0.46	0.56	0.66
Cardiothoracic	48	406,648	0.86	0.72	0.83	0.90	0.95	0.96
Medical	127	1,055,251	0.71	0.47	0.62	0.73	0.82	0.88
Medical/Surgical Major teaching	72	432,959	0.78	0.54	0.70	0.80	0.84	0.89
Medical/Surgical All others	141	1,204,728	0.73	0.52	0.62	0.74	0.82	0.88
Neurosurgical	46	245,244	0.79	0.53	0.68	0.81	0.90	0.93
Pediatric	70	550,661	0.32	0.13	0.20	0.29	0.40	0.48
Surgical	146	1,221,149	0.83	0.65	0.77	0.85	0.91	0.95
Trauma	21	148,606	0.87	0.64	0.73	0.90	0.93	0.96
Burn	17	59,578	0.55	.	.	.	.	.
Respiratory	7	45,886	0.63	.	.	.	.	.

Central line utilization**

Type of ICU	No. of Units	Patient-Days	Pooled Mean	Percentile				
				10%	25%	50% (median)	75%	90%
Coronary	108	770,739	0.28	0.13	0.18	0.26	0.35	0.50
Cardiothoracic	48	406,648	0.80	0.62	0.74	0.84	0.87	0.95
Medical	126	1,055,251	0.50	0.29	0.36	0.48	0.61	0.72
Medical/Surgical Major teaching	72	432,959	0.55	0.37	0.42	0.56	0.66	0.74
Medical/Surgical All others	141	1,204,728	0.44	0.21	0.31	0.44	0.55	0.65
Neurosurgical	46	245,244	0.43	0.24	0.37	0.46	0.55	0.61
Pediatric	70	550,661	0.45	0.25	0.34	0.44	0.56	0.65
Surgical	146	1,221,149	0.67	0.49	0.57	0.68	0.77	0.88
Trauma	21	148,606	0.63	0.39	0.50	0.62	0.68	0.76
Burn	17	59,578	0.43	.	.	.	.	.
Respiratory	7	45,886	0.34	.	.	.	.	.

Ventilator utilization***

Type of ICU	No. of Units	Patient-Days	Pooled Mean	Percentile				
				10%	25%	50% (median)	75%	90%
Coronary	106	770,739	0.19	0.07	0.11	0.17	0.26	0.32
Cardiothoracic	48	406,648	0.48	0.32	0.38	0.50	0.55	0.64
Medical	126	1,055,251	0.48	0.23	0.32	0.45	0.58	0.68
Medical/Surgical Major teaching	72	432,959	0.44	0.26	0.34	0.44	0.54	0.62
Medical/Surgical All others	141	1,204,728	0.35	0.18	0.24	0.34	0.41	0.51
Neurosurgical	46	245,244	0.37	0.21	0.28	0.39	0.46	0.58
Pediatric	70	550,661	0.47	0.21	0.33	0.43	0.51	0.58
Surgical	146	1,221,149	0.47	0.24	0.35	0.47	0.55	0.65
Trauma	21	148,606	0.56	0.35	0.43	0.59	0.64	0.71
Burn	17	59,578	0.33	.	.	.	.	.
Respiratory	7	45,886	0.50	.	.	.	.	.

* $\frac{\text{Number of urinary catheter-days}}{\text{Number of patient-days}}$

** $\frac{\text{Number of central line-days}}{\text{Number of patient-days}}$

*** $\frac{\text{Number of ventilator-days}}{\text{Number of patient-days}}$

Table 3. Distribution of the most common pathogens isolated from bloodstream infections, by type of ICU*, NNIS system, January 1992-May 1999

PATHOGEN	TYPE OF ICU																			
	Burn		Coronary Care		Cardiothoracic		Medical		Medical/ Surgical		Neurosurgical		Pediatric		General Surgery		Trauma		Total	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Enterobacter spp.	54	11.2	44	2.9	65	6.2	132	3.1	173	3.6	36	4.1	163	6.8	330	5.8	86	10.4	1,083	4.9
E. coli	16	3.3	43	2.8	21	2.0	92	2.1	96	2.0	23	2.6	72	3.0	127	2.2	24	2.9	514	2.3
K. pneumoniae	16	3.3	33	2.2	23	2.2	167	3.9	110	2.3	27	3.1	103	4.3	228	4.0	28	3.4	735	3.4
P. aeruginosa	46	9.5	31	2.1	27	2.6	157	3.6	160	3.4	32	3.7	116	4.9	237	4.1	35	4.3	841	3.8
S. aureus	85	17.6	352	23.2	95	9.0	600	14.0	582	12.2	115	13.1	232	9.7	597	10.4	100	12.1	2,758	12.6
CNS†	67	13.9	561	37.0	448	42.7	1,530	35.7	1,954	40.9	391	44.6	902	37.7	2,071	36.1	257	31.1	8,181	37.3
Enterococcus spp.	75	15.5	154	10.2	150	14.3	706	16.5	552	11.5	99	11.3	257	10.7	876	15.3	98	11.9	2,967	13.5
C. albicans	21	4.4	40	2.6	46	4.4	269	6.3	283	5.9	26	3.0	121	5.1	259	4.5	25	3.0	1,090	5.0
All other pathogens	103	21.3	257	17.0	174	16.6	634	14.8	870	18.2	127	14.5	426	17.8	1,010	17.6	173	20.9	3,774	17.2
Total	483	100.0	1,515	100.0	1,049	100.0	4,287	100.0	4,780	100.0	876	100.0	2,392	100.0	5,735	100.0	826	100.0	21,943	100.0

*Includes all ICU infections reported from hospitals performing either the ICU or hospital-wide surveillance components during the time period.
†Coagulase-negative staphylococci

Table 4. Distribution of the most common pathogens isolated from pneumonia, by type of ICU*, NNIS system, January 1992-May 1999

PATHOGEN	TYPE OF ICU																			
	Burn		Coronary Care		Cardiothoracic		Medical		Medical/ Surgical		Neurosurgical		Pediatric		General Surgery		Trauma		Total	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Enterobacter spp.	51	8.0	207	9.8	375	13.1	512	8.6	1,022	10.6	257	10.5	182	9.8	1,557	12.8	281	13.4	4,444	11.2
E. coli	21	3.4	88	4.2	139	4.8	211	3.5	402	4.1	112	4.6	66	3.6	593	4.9	93	4.4	1,725	4.3
K. pneumoniae	34	5.3	176	8.4	169	5.9	461	7.7	720	7.4	182	7.5	99	5.4	878	7.2	146	7.0	2,865	7.2
H. influenzae	42	6.6	65	3.1	165	5.8	87	1.5	340	3.5	181	7.4	171	9.3	532	4.4	155	7.4	1,738	4.3
P. aeruginosa	137	21.5	314	14.9	375	13.1	1,264	21.2	1,507	15.5	294	12.1	414	22.4	2,087	17.2	360	17.1	6,752	17.0
S. aureus	157	24.7	425	20.2	326	11.3	1,273	21.4	1,750	18.0	527	21.6	303	16.4	2,065	17.0	379	18.1	7,205	18.1
Enterococcus spp.	12	1.9	37	1.8	66	2.3	102	1.7	177	1.8	32	1.3	17	0.9	215	1.8	24	1.1	682	1.7
C. albicans	18	2.8	133	6.3	180	6.3	298	5.0	592	6.1	104	4.3	37	2.0	468	3.9	32	1.5	1,862	4.7
All other pathogens	164	25.8	658	31.3	1,073	37.4	1,752	29.4	3,197	33.0	749	30.7	559	30.2	3,759	30.9	626	29.9	12,537	31.5
Total	636	100.0	2,103	100.0	2,868	100.0	5,960	100.0	9,707	100.0	2,438	100.0	1,848	100.0	12,154	100.0	2,096	100.0	39,810	100.0

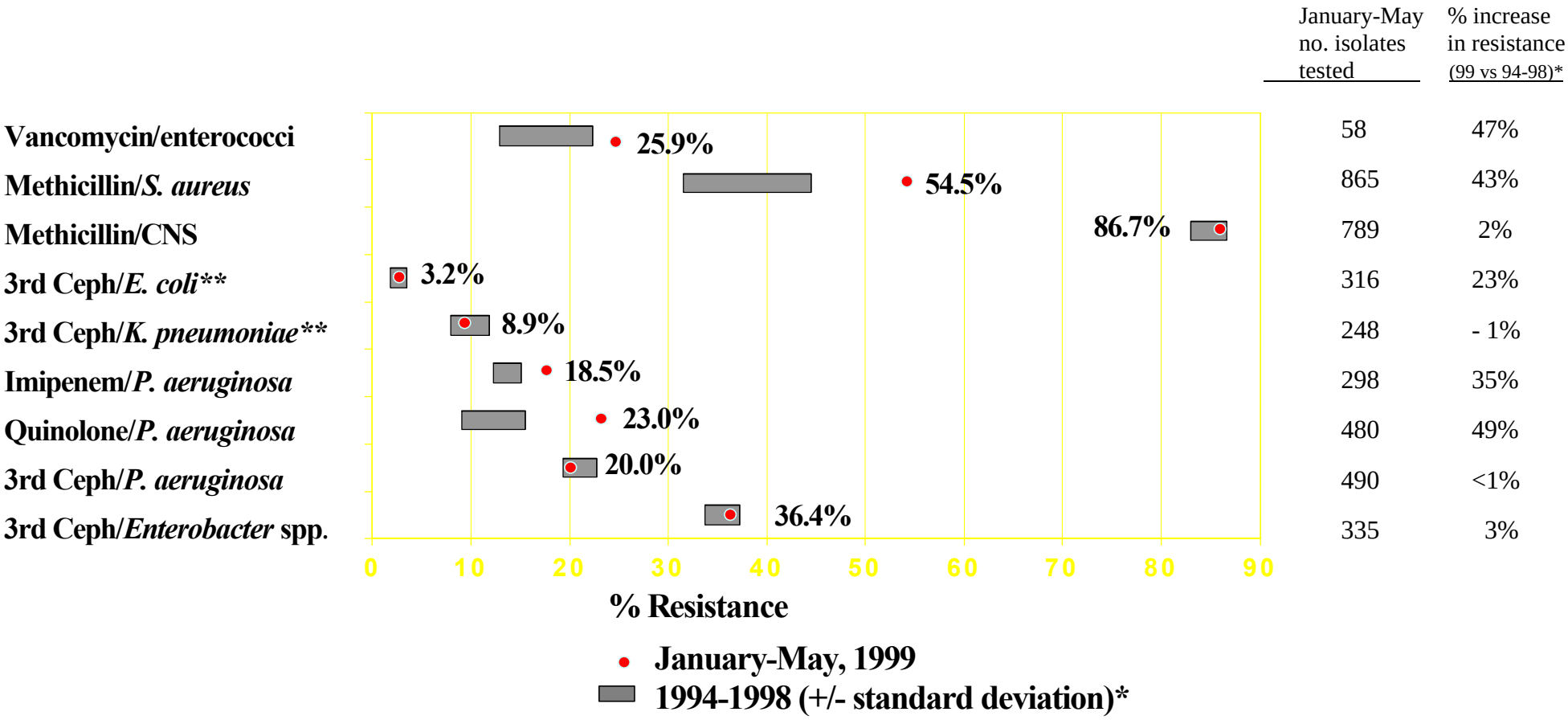
*Includes all ICU infections reported from hospitals performing either the ICU or hospital-wide surveillance components during the time period.

Table 5. Distribution of the most common pathogens isolated from urinary tract infections, by type of ICU*, NNIS system, January 1992-May 1999

PATHOGEN	TYPE OF ICU																	
	Burn		Coronary Care		Cardiothoracic		Medical		Medical/ Surgical		Neurosurgical		Pediatric		General Surgery		Trauma		Total	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Enterobacter spp.	29	6.7	120	3.9	78	5.9	284	4.1	328	4.3	101	5.1	126	9.5	417	6.2	77	6.5	1,560	5.1
E. coli	59	13.7	805	26.0	165	12.5	947	13.7	1,378	17.9	557	28.3	255	19.2	988	14.6	239	20.1	5,393	17.5
K. pneumoniae	20	4.7	242	7.8	81	6.1	435	6.3	404	5.3	155	7.9	91	6.8	410	6.1	53	4.5	1,891	6.2
P. aeruginosa	86	20.0	202	6.5	166	12.6	668	9.7	786	10.2	215	10.9	190	14.3	891	13.1	161	13.5	3,365	11.0
S. aureus	11	2.6	72	2.3	8	0.6	121	1.8	123	1.6	38	1.9	18	1.3	86	1.3	20	1.7	497	1.6
CNS†	9	2.1	100	3.2	21	1.6	159	2.3	245	3.2	74	3.8	57	4.3	131	1.9	42	3.5	838	2.7
Enterococcus spp.	78	18.1	443	14.3	113	8.5	977	14.2	1,083	14.1	235	11.9	128	9.6	985	14.5	184	15.5	4,226	13.8
C. albicans	36	8.4	315	10.2	277	21.0	1,437	20.8	1,211	15.7	159	8.1	186	14.0	1,106	16.3	129	10.8	4,856	15.8
All other pathogens	102	23.7	798	25.8	412	31.2	1,866	27.1	2,135	27.7	434	22.1	280	21.0	1,764	26.0	284	23.9	8,075	26.3
Total	430	100.0	3,097	100.0	1,321	100.0	6,894	100.0	7,693	100.0	1,968	100.0	1,331	100.0	6,778	100.0	1,189	100.0	30,701	100.0

*Includes all ICU infections reported from hospitals performing either the ICU or hospital-wide surveillance components during the time period.
†Coagulase-negative staphylococci

Figure 1. Selected antimicrobial resistant pathogens associated with nosocomial infections in ICU patients, comparison of resistance rates from January-May 1999 with 1994-1998, NNIS System



Note: CNS=coagulase-negative staphylococci, 3rd Ceph = resistance to 3rd generation cephalosporins (either ceftriaxone, cefotaxime, or ceftazidime), quinolone=resistance to either ciprofloxacin or ofloxacin.

* Percentage (%) increase in resistance rate of current year (January-May 1999) compared to mean rate of resistance over previous 5 years (1994 through 1998): [(1999 rate - previous 5 year mean rate)/previous 5 year mean rate]*100.

** "Resistance" for *E. coli* or *K. pneumoniae* is the rate of non-susceptibility of these organisms to either 3rd Ceph group or aztreonam.

Table 6. High risk nursery surveillance component. Pooled means and percentiles of the distribution of device-associated infection rates, by birthweight category, NNIS system, January 1990 - May 1999

Umbilical and central line-associated BSI rate*

Birthweight Category	No. of HRNs	Central-Line Days	Pooled Mean	Percentile				
				10%	25%	50% (median)	75%	90%
#1000 grams	121	344,999	12.2	4.9	7.3	12.0	16.3	19.7
1001-1500 grams	120	163,124	7.6	1.3	3.8	6.7	11.0	15.7
1501-2500 grams	122	138,766	5.0	0.0	1.5	3.9	7.1	10.8
> 2500 grams	124	200,852	4.5	0.0	1.2	3.7	6.3	9.6

Ventilator-associated pneumonia rate**

Birthweight Category	No. of HRNs	Ventilator-Days	Pooled Mean	Percentile				
				10%	25%	50% (median)	75%	90%
# 1000 grams	121	369,155	4.9	0.0	1.6	4.0	7.6	10.7
1001-1500 grams	118	116,936	3.9	0.0	0.0	2.5	6.3	9.6
1501-2500 grams	117	91,341	3.5	0.0	0.0	2.0	4.3	8.0
> 2500 grams	118	135,352	2.8	0.0	0.0	1.0	3.7	6.2

* $\frac{\text{Number of umbilical and central line-associated BSIs}}{\text{Number of umbilical and central line-days}} \times 1000$

** $\frac{\text{Number of ventilator-associated Pneumonias}}{\text{Number of ventilator-days}} \times 1000$

Table 7. High risk nursery surveillance component. Pooled means and percentiles of the distribution of device utilization ratios, by birthweight category, NNIS system, January 1990-May 1999

Umbilical and central line utilization ratio*

Birthweight Category	No. of HRNs	Patient-Days	Pooled Mean	Percentile				
				10%	25%	50% (median)	75%	90%
# 1000 grams	123	865,182	0.40	0.18	0.28	0.36	0.52	0.65
1001-1500 grams	123	611,965	0.27	0.09	0.14	0.23	0.38	0.51
1501-2500 grams	129	680,354	0.20	0.05	0.09	0.16	0.28	0.46
> 2500 grams	129	653,471	0.31	0.07	0.12	0.23	0.38	0.52

Ventilator utilization ratio**

Birthweight Category	No. of HRNs	Patient-Days	Pooled Mean	Percentile				
				10%	25%	50% (median)	75%	90%
# 1000 grams	123	865,182	0.43	0.24	0.32	0.40	0.52	0.65
1001-1500 grams	123	611,965	0.19	0.07	0.10	0.15	0.27	0.38
1501-2500 grams	129	680,354	0.13	0.03	0.06	0.10	0.17	0.32
> 2500 grams	129	653,471	0.21	0.05	0.08	0.14	0.25	0.37

*$\frac{\text{Number of umbilical and central line-days}}{\text{Number of patient-days}}$

**$\frac{\text{Number of ventilator-days}}{\text{Number of patient-days}}$

Table 8. Surgical patient surveillance component. Surgical site infection rates[‡], by operative procedure and risk index category, NNIS system, 1992-1998

Operative Procedure Category	Duration Cutpoint (hrs)	Risk Index Category	N	Rate	Risk Index Category	N	Rate	Risk Index Category	N	Rate	Risk Index Category	N	Rate
CARD Cardiac Surgery	5	0	1021	0.59	1	13285	1.69	2,3	4010	2.84	.	.	.
CBGB* CABG-Chest & Leg	5	0	1098	0.73	1	113169	3.46	2	22942	5.82	3	57	17.54
CBGC** CABG-Chest Only	4	0,1	6210	2.62	2,3	2420	4.05		.	.	.	.	.
OCVS Other Cardiovascular Surg	2	0,1	5313	0.77	2	1660	1.69	3	69	5.80	.	.	.
ORES Other Respiratory System	2	0,1,2,3	1352	2.74		.	.		.	.	.	.	.
THOR Thoracic Surgery	3	0	936	0.43	1	2876	1.29	2,3	1048	3.24	.	.	.
BILI Liver/Pancreas	4	0	309	3.24	1,2,3	1094	7.04		.	.	.	.	.
OGIT Other Digestive Surgery	3	0,1	2290	3.23	2,3	432	8.10		.	.	.	.	.
SB Small Bowel Surgery	3	0	823	5.59	1	1876	7.52	2	1010	9.80	3	183	14.75
XLAP Laparotomy	2	0	3733	1.69	1	4125	3.15	2	2181	5.36	3	363	7.99
NEPH Nephrectomy	4	0,1,2,3	2046	1.22		.	.		.	.	.	.	.
OGU Other Genitourinary Surgery	2	0	8946	0.44	1	4016	1.17	2,3	983	2.95	.	.	.
PRST Prostatectomy	4	0	1648	0.91	1,2,3	1306	2.68		.	.	.	.	.
HN Head and Neck	7	0	442	2.94	1	595	5.71	2,3	280	13.93	.	.	.
OENT Other ENT	2	0,1	2474	0.24	2,3	272	2.94		.	.	.	.	.
HER Herniorrhaphy	2	0	7251	0.79	1	3982	1.86	2,3	901	3.44	.	.	.
MAST Mastectomy	3	0,1	11178	2.07	2,3	403	3.97		.	.	.	.	.
CRAN Craniotomy	4	0	2054	0.58	1,2,3	8112	1.75		.	.	.	.	.
ONS Other Nervous System	4	0,1,2,3	1648	1.76		.	.		.	.	.	.	.
VSHN Ventricular Shunt	2	0	1549	3.68	1,2,3	3573	5.12		.	.	.	.	.
CSEC Cesarean Section	1	0	59921	3.27	1	19920	4.74	2,3	1641	8.65	.	.	.

Table 8 - continued

Operative Procedure Category	Duration Cutpoint (hrs)	Risk Index Category	N	Rate	Risk Index Category	N	Rate	Risk Index Category	N	Rate	Risk Index Category	N	Rate
HYST Abdominal Hysterectomy	2	0	17590	1.50	1	9504	2.47	2,3	2012	6.11	.	.	.
OOB Other Obstetric Procedures	1	0,1,2,3	793	0.50		.	.		.	.	.	.	.
VHYS Vaginal Hysterectomy	2	0	7959	1.08	1,2,3	3937	1.47		.	.	.	.	.
AMP Limb Amputation	1	0,1,2,3	5991	4.29		.	.		.	.	.	.	.
FUSN Spinal Fusion	4	0	12306	1.23	1	7206	3.07	2,3	1979	7.23	.	.	.
FX Open Reduction Fracture	2	0	8474	0.64	1	12709	1.33	2,3	2931	2.59	.	.	.
HPRO Hip Prosthesis	2	0	9841	0.78	1	17638	1.55	2,3	5120	2.07	.	.	.
KPRO Knee Prosthesis	2	0	13721	0.87	1	17101	1.22	2,3	4928	2.03	.	.	.
LAM Laminectomy	2	0	18951	0.85	1	14064	1.38	2,3	4122	2.57	.	.	.
OMS Other Musculoskeletal	3	0	9493	0.65	1	6680	0.93	2,3	1788	2.07	.	.	.
OPRO Other Prosthesis	3	0,1,2,3	1396	0.64		.	.		.	.	.	.	.
OBL Other Hem/Lymph System	3	0,1,2,3	844	2.01		.	.		.	.	.	.	.
OES Other Endocrine System	3	0	1364	0.15	1,2,3	1046	0.96		.	.	.	.	.
OEYE Other Eye	2	0,1,2,3	437	0.69		.	.		.	.	.	.	.
OSKN Other Integumentary System	2	0,1,2,3	5501	1.38		.	.		.	.	.	.	.
SKGR Skin Graft	3	0,1	1872	1.44	2,3	806	4.47		.	.	.	.	.
SPLE Splenectomy	3	0,1,2,3	1016	2.85		.	.		.	.	.	.	.
TP Organ Transplant	7	0,1	2077	5.39	2,3	5711	6.99		.	.	.	.	.
VS Vascular Surgery	3	0	3579	0.98	1	30595	1.79	2,3	12515	5.05	.	.	.

‡per 100 operations
*CBGB (chest and leg) = Coronary artery bypass graft, chest and leg (donor) incisions
**CBGC (chest only) = Coronary artery bypass graft, chest incision only (example: internal mammary artery)

Table 9. Surgical patient surveillance component. Percentiles of the distribution of surgical site infection rates[‡], by operative procedure and risk index category[§], NNIS system, 1992 - 1998

Operative Procedure Category	Risk Index Category	No. Hospitals	Pooled Mean Rate	Percentile				
				10%	25%	50% (median)	75%	90%
CARD Cardiac Surgery	1	71	1.69	0.00	0.00	1.28	2.06	3.46
CARD Cardiac Surgery	2,3	45	2.84	0.00	0.00	2.01	3.96	6.57
CBGB* CABG-Chest & Leg	1	123	3.46	1.09	1.92	2.95	4.29	6.70
CBGB* CABG-Chest & Leg	2	107	5.82	1.30	3.09	5.43	7.80	10.82
CBGC** CABG-Chest Only	0,1	52	2.62	0.00	0.00	1.33	3.38	4.43
CBGC** CABG-Chest Only	2,3	29	4.05	0.00	0.00	1.81	3.61	6.16
OCVS Other Cardiovascular Surgery	0,1	27	0.77	0.00	0.00	0.00	1.38	2.97
THOR Thoracic Surgery	1	31	1.29	0.00	0.00	0.00	2.01	2.77
OGIT Other Digestive Tract Surgery	0,1	21	3.23	0.00	1.41	2.38	5.05	7.36
SB Small Bowel Surgery	1	24	7.52	2.49	4.17	6.38	10.42	16.80
XLAP Laparotomy	0	30	1.69	0.00	0.00	1.43	2.40	4.55
XLAP Laparotomy	1	37	3.15	0.00	0.23	2.60	3.98	6.69
XLAP Laparotomy	2	25	5.36	0.00	1.25	4.04	7.84	9.80
NEPH Nephrectomy	0,1,2,3	24	1.22	0.00	0.00	0.00	1.92	4.01
OGU Other Genitourinary	0	28	0.44	0.00	0.00	0.25	1.04	1.45
OGU Other Genitourinary	1	25	1.17	0.00	0.11	0.64	2.08	3.30
PRST Prostatectomy	0	23	0.91	0.00	0.00	0.00	1.05	3.09
HER Herniorrhaphy	0	40	0.79	0.00	0.00	0.24	1.45	2.33
HER Herniorrhaphy	1	39	1.86	0.00	0.00	1.10	2.94	3.85
MAST Mastectomy	0,1	48	2.07	0.00	0.00	0.86	2.42	3.42
CRAN Craniotomy	0	26	0.58	0.00	0.00	0.00	1.34	2.38
CRAN Craniotomy	1,2,3	51	1.75	0.00	0.00	0.92	2.36	3.23
VSHN Ventricular Shunt	1,2,3	30	5.12	0.00	1.15	3.84	6.16	9.76
CSEC Cesarean Section	0	96	3.27	0.00	1.21	2.59	5.69	9.12
CSEC Cesarean Section	1	87	4.74	0.00	1.56	3.38	7.16	9.77
CSEC Cesarean Section	2,3	22	8.65	0.00	4.27	6.60	13.07	18.08
HYST Abdominal Hysterectomy	0	66	1.50	0.00	0.00	1.16	2.33	4.23
HYST Abdominal Hysterectomy	1	63	2.47	0.00	0.00	1.55	2.79	4.71
HYST Abdominal Hysterectomy	2,3	29	6.11	0.00	2.74	4.71	9.42	11.61

Table 9 - continued

Operative Procedure Category	Risk Index Category	No. Hospitals	Pooled Mean Rate	Percentile				
				10%	25%	50% (median)	75%	90%
VHYS Vaginal Hysterectomy	0	33	1.08	0.00	0.00	0.52	1.62	3.93
VHYS Vaginal Hysterectomy	1,2,3	34	1.47	0.00	0.00	1.15	1.95	4.23
AMP Limb Amputation	0,1,2,3	36	4.29	0.00	1.57	3.25	5.37	8.39
FUSN Spinal Fusion	0	57	1.23	0.00	0.00	0.47	1.45	2.56
FUSN Spinal Fusion	1	55	3.07	0.00	0.00	2.08	4.02	6.36
FUSN Spinal Fusion	2,3	26	7.23	0.00	4.67	7.02	9.60	13.46
FX Open Reduction Fracture	1	60	1.33	0.00	0.00	0.90	1.64	2.37
HPRO Hip Prosthesis	0	91	0.78	0.00	0.00	0.00	1.09	2.81
HPRO Hip Prosthesis	1	119	1.55	0.00	0.00	1.04	2.35	3.85
HPRO Hip Prosthesis	2,3	73	2.07	0.00	0.00	1.06	3.80	6.29
KPRO Knee Prosthesis	0	91	0.87	0.00	0.00	0.31	1.59	2.80
KPRO Knee Prosthesis	1	111	1.22	0.00	0.00	0.93	1.91	3.24
KPRO Knee Prosthesis	2,3	68	2.03	0.00	0.00	1.47	3.45	5.56
LAM Laminectomy	0	83	0.85	0.00	0.00	0.47	1.13	2.66
LAM Laminectomy	1	77	1.38	0.00	0.00	1.01	2.37	3.38
LAM Laminectomy	2,3	51	2.57	0.00	0.00	2.41	3.57	6.90
OMS Other Musculoskeletal	0	34	0.65	0.00	0.00	0.45	0.83	0.96
OMS Other Musculoskeletal	1	32	0.93	0.00	0.00	0.00	1.23	1.88
OSKN Other Integumentary System	0,1,2,3	26	1.38	0.00	0.00	0.95	1.49	2.39
VS Vascular Surgery	0	47	0.98	0.00	0.00	0.00	1.68	3.94
VS Vascular Surgery	1	83	1.79	0.00	0.71	1.38	2.25	3.50
VS Vascular Surgery	2,3	77	5.05	0.00	2.87	4.65	7.2	9.18
FX Open Reduction Fracture	2,3	35	2.59	0.00	0.00	2.80	4.40	7.50

‡ per 100 operations
§Includes only those procedure-risk categories for which at least 20 hospitals have reported at least 30 operations.
*CABG-Chest and Leg = Coronary artery bypass graft, chest and leg (donor) incisions
**CABG-Chest Only = Coronary artery bypass graft, chest incision only (example: internal mammary artery)

Table 10. Surgical patient component. Surgical site infection rates*, by selected operative procedure and modified risk index category incorporating laparoscope use, 1992-1998**

Operative Procedure Category	Duration Cutpoint (hrs)	Risk Index Category	N	Rate	Risk Index Category	N	Rate	Risk Index Category	N	Rate	Risk Index Category	N	Rate	Risk Index Category	N	Rate
CHOL Cholecystectomy	2	M	17,095	0.49	0	15,471	0.69	1	7,417	2.04	2	2,492	3.49	3	318	6.60
COLO Colon Surgery	3	M	288	0.69	0	6,812	4.32	1	11,856	6.24	2	5,267	9.55	3	718	12.95
APPY Appendectomy	1	0-Yes	893	0.56	0-No	3,866	1.37	1	4,957	3.17	2,3	2,121	5.85	.	.	.
GAST Gastric Surgery	3	0-Yes	203	0.49	0-No	1,144	2.71	1	2,416	5.13	2,3	1,184	10.73	.	.	.

*per 100 operations

**This table uses a new modified risk index that incorporates the influence of laparoscope or endoscope (SCOPE) on SSI rates. The influence of SCOPE on SSI rates was different across the four procedures:

- For Cholecystectomy and Colon Surgery, when the operation was done laparoscopically, 1 was subtracted from the number of risk factors (ASA score of 3,4, or 5; duration of surgery >75th percentile; or contaminated or dirty wound class) in the NNIS risk index. For example, when two risk factors were present and the procedure was done laparoscopically, the new modified risk index category is 1 (i.e., 2-1=1). When no risk factors were present and the procedure was performed with a laparoscope, i.e., 0-1=-1, we designated this new modified risk category as minus 1 or "M".
- For Appendectomy and Gastric Surgery, the use of a SCOPE was important only if the patient had no other risk factors. We split patients with no other risk factors into two groups: '0-Yes' which means laparoscope was used and '0-No' when laparoscope was not used. Since there was no difference in the rates when 2 or 3 risk factors were present, the rates for categories 2 and 3 were combined into a single category.

Table 11. Surgical patient surveillance component. Surgical site infection rates* following coronary artery bypass graft (CBGB) procedure, by risk index category and specific site, NNIS system, January 1992 - December 1997

Infection Site	Risk Index Category							
	0		1		2		3	
	No. SSIs	Rate	No. SSIs	Rate	No. SSIs	Rate	No. SSIs	Rate
Leg (donor site)	**4**	**0.36**	**1798**	**1.59**	**644**	**2.81**	**2**	**3.51**
Superficial incisional	*4*	*0.36*	*1453*	*1.28*	*504*	*2.20*	*2*	*3.51*
Deep incisional	*0*	*0.00*	*345*	*0.30*	*140*	*0.61*	*0*	*0.00*
Chest	**4**	**0.36**	**2120**	**1.87**	**692**	**3.02**	**8**	**14.04**
Superficial incisional	*3*	*0.27*	*892*	*0.79*	*285*	*1.24*	*2*	*3.51*
Deep incisional	*0*	*0.00*	*560*	*0.49*	*185*	*0.81*	*3*	*5.26*
Organ/space	*1*	*0.09*	*668*	*0.59*	*222*	*0.97*	*3*	*5.26*
Total	**8**	**0.73**	**3918**	**3.46**	**1336**	**5.82**	**10**	**17.54**

*per 100 operations.

Denominators for the risk categories are as follows:

Category 0 = 1, 098
Category 1 = 113, 169
Category 2 = 22, 942
Category 3 = 57

Appendix A. How to calculate device-associated infection rates and device utilization ratios using ICU and HRN surveillance component data

Calculation of Device-associated Infection Rate

Step 1: Decide upon the time period for your analysis. It may be a month, a quarter, 6 months, a year, or som

Step 2: Select the patient population for analysis, i.e., the type of ICU or a birthweight category in the HRN.

Step 3: Select the infections to be used in the numerator. They must be site-specific and must have occurred patient population. Their date of onset must be during the selected time period.

Step 4: Determine the number of device-days which is used as the denominator of the rate. Device-days are t of days of exposure to the device (central line, ventilator, or urinary catheter) by all of the patients in t population during the selected time period.

> ***Example 1***: Five patients on the first day of the month had one or more central lines in place; fi 2; two on day 3; five on day 4; three on day 5; four on day 6; and four on day 7. Adding the nu patients with central lines on days 1 through 7, we would have 5+5+2+5+3+4+4=28 central line first week. If we continued for the entire month, the number of central line-days for the month i sum of the daily counts.

Step 5: Calculate the device-associated infection rate (per 1000 device-days) using the following formula:

> **Device-associated Infection Rate** =
> Number of device-associated infections for a specific site x 1000
> Number of device-days
>
> ***Example 2***: **Central line-associated BSI rate per 1000 central line-days =**
> Number of central line-associated BSI x 1000
> Number of central line-days

Calculation of Device Utilization (DU) Ratio

Steps 1,2,4: Same as device-associated infection rates plus determine the number of patient-days which is us denominator of the DU ratio. Patient-days are the total number of days that patients are in the I during the selected time period (sum of the '#patients' column on the monthly ICU and HRN da forms)..

Example 3: Ten patients were in the unit on the first day of the month; 12 on day 2; 11 on day 3 4; 10 on day 5; 6 on day 6; and 10 on day 7; and so on. If we counted the patients in the unit fr through 7, we would add 10 + 12 + 11 + 13 + 10 + 6 + 10 for a total of 72 patient-days for the fi month. If we continued for the entire month, the number of patient-days for the month is simpl the daily counts.

Step 5: Calculate the DU ratio using the following formula:

$$\text{Device Utilization (DU) Ratio} = \frac{\text{Number of device-days}}{\text{Number of patient-days}}$$

With the number of device-days and patient-days from Examples 1 and 3 above,
DU = 28/72 = 0.39 or 39% of patient-days were also central line-days for the first week of the m

Step 6: Examine the size of the denominator for your hospital's rate or ratio. Rates or ratios may not be goo the "true" rate or ratio for your hospital if the denominator is small, i.e., <50 device-days or patient-d

Step 7: Compare your hospital's ICU/HRN rates or ratios with those found in the tables of this report. Refer for interpretation of the percentiles of the rates/ratios.

To calculate the device-associated infection rates and device utilization ratios for your ICU or HRN in IDEAS, first select the time period of interest in Option 10 of the OPM. Then select either OPM Option 21 or 22 to include infections based on date of infection onset. Next, select OPM Option 32 for ICU or Option 33 for HRN. From these data analysis menus, device-associated infection rates and device utilization ratios can be automatically calculated using Options 31 or 32.

Appendix B. How to interpret percentiles of infection rates or device utilization ratios

Step 1: Evaluate the rate (ratio) you have calculated for your hospital and confirm that the variables in the rate (both numerator and denominator) are identical to the rates (ratios) in the table.

Step 2: Examine the percentiles in each of the tables and look for the 50th percentile (or median). At the 50th percentile, 50% of the hospitals have lower rates (ratios) than the median and 50% have higher rates (ratios).

Step 3: Determine if your hospital's rate (ratio) is above or below this median.

Determining if your hospital's rate or ratio is a HIGH outlier

Step 4: If it is above the median, determine whether the rate (ratio) is above the 75th percentile. At the 75th percentile, 75% of the hospitals had **lower** rates (ratio) and 25% of the hospital had higher rates (ratio).

Step 5: If the rate (ratio) is above the 75th percentile, determine whether it is above the 90th percentile. If it is, then the rate (or ratio) is a high outlier which **may** indicate a problem.

Determining if your hospital's rate or ratio is a LOW outlier

Step 6: If it is below the median, determine whether the rate (ratio) is below the 25th percentile. At the 25th percentile, 25% of the hospitals had **lower** rates (ratios) and 75% of the hospitals had higher rates (ratios).

Step 7: If the rate (ratio) is below the 25th percentile, determine whether it is below the 10th percentile. If the rate is, then it is a low outlier which **may** indicate a problem with underreporting of infections. If the ratio is below the 10th percentile, it is a low outlier and indicates infrequent and/or short duration of device use.

Note: Device-associated infection rates and device utilization ratios should be examined together so that preventive measures may be appropriately targeted. For example, you find that the ventilator-associated pneumonia rate for a certain type of ICU is consistently above the 90th percentile and the ventilator utilization ratio is routinely between the 75th and 90th percentile. Since the ventilator is a significant risk factor for pneumonia, you may want to target your efforts on reducing the use of ventilators or limiting the duration with which they are used on patients in order to lower the pneumonia rate in the unit.

Appendix C. How to use IDEAS to calculate SSI rates from the surgical patient surveillance component

If you have been following the surgical patient surveillance component and wish to calculate SSI rates in IDEAS, first select the time period of interest using Option 10 of the OPM. Then select either OPM Option 23 or 24 to include infections based on date of surgery. Next, select OPM Option 34 to go to the SP Component Data Analysis Menu. Select Option 35 for the SP Rates Menu #1. Here, modify the SP filter (Option 60) to include only SSI and specify operative procedures and/or surgeons, if desired. For example:

majsite = ssi
and srgoper = cbgb or cbgc
and surgeon = 12345

Select SP Rates Menu #1 Option 1 to calculate SSI rates by operative procedure and risk index category. Select Option 5 to calculate SSI rates by operative procedure and risk index category by surgeon.